
Xanadu Light, March 94.

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"Xanadu," "Xanadu Light," "HyPerformance" and the Eternal
Flaming X symbol are trademarks of Project Xanadu.

This is an unpolished and preliminary introduction to Xanadu Light, especially its table and data structures. I assume that the reader knows in general what this is about.

OVERVIEW

Xanadu has long been a software design, an ideal, and an action plan for a worldwide linked electronic publishing system. (Note that the system was also designed from the beginning for version and document management on a personal and corporate scale, but version management has been dropped from the current system. We expect to put in a form of version management at a later time.)

Openness and Freedom

We believe the Xanadu system offers unique solutions to issues of royalty, rights and re-use.

Our electronic publishing model has been unique: a scheme for open, integrated universal electronic publishing with freedom for anyone to publish. Anyone may publish any form of data, and anyone may publish links to already-published material.

Mix-and-Match Boilerplate

The system is defined so that all parts of a published document may be purchased a la carte in pieces. Anything already published within the system may also be re-used and re-published with ease within the system. Thus text, graphics, audio, animations, simulations may be recombined on a mix-and-match basis. This is true for links as well.

Re-Use

All parties agree by contract that materials may be re-used freely, but only by virtual inclusion in new Xanadu documents. Thus everyone is free to use previous materials

in new ways, but royalty and credit automatically go to the rightsholder.

Clean Data

Links and markers are local applicative substructures, and not embedded in any way. This better facilitates re-use of the material.

Automatic Royalty

Each time a customer buys a fragment of any data-- text, graphics, audio, 3D models, whatever-- a proportional royalty payment automatically goes from the customer to the publisher. Anything may be bought in small portions.

Licensed Service Providers

The plan has also been to license, or franchise, service providers, who will set up computers and data storage using our software, and make the service available to customers locally and internationally. Customers may modem in to their local service providers. The service providers, in turn, will be able to send for materials they do not have locally.

Really a Business Model

Essentially this is a business model, and the type of implementation is secondary.

Xanadu Light

XANADU LIGHT is the new implementation now being planned for implementation with conventional database on the Internet.

What follows is a design specification for that Xanadu Light.

00. THE BUSINESS MODEL

The service provider is not responsible for the contents.

The publisher is responsible for contents, and pays for storage.

The reader/user pays for delivery, including both

a service charge to the service provider, and

a royalty to the publisher. This royalty is exactly

proportional to the number of bytes, at the royalty price set

by the publisher on that document, or set by the publisher on

a particular segment of that document.

THE CONTRACTS

Contracts bind the system.

Publisher --

is responsible for the contents and relinquishes context control of the materials in the Xanadu network in return for royalty and credit. Publisher retains all other rights.

Reader --

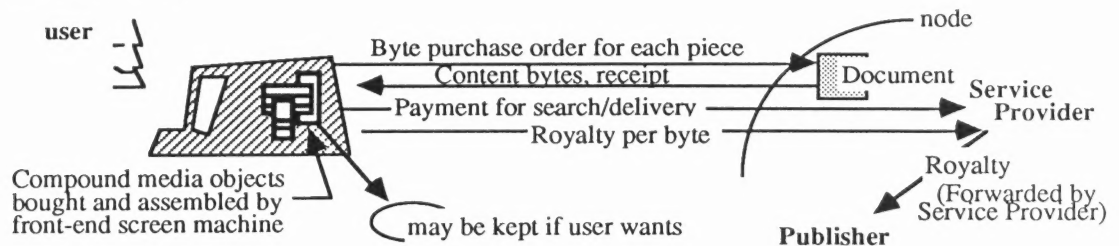
agrees to terms of purchase, and agrees not to redistribute the materials except through transclusion into documents published within the Xanadu network.

Service provider --

agrees to maintain integrity of the document, use the software provided, and remand royalties and other payments as called for.

0. THE MODEL OF INTERACTION

The user perceives a point-and-click universe. In actuality, each click makes another small purchase of content bytes or links from the network.



THE RECEIPT

A receipt will be sent with each portion. This will assist the user, or the user's system, in filing the portion, if the user chooses to keep it. The receipt will also authenticate, by means of a hash code, the user's legitimate purchase of this portion.

CLIENT SOFTWARE

Basic purchase will be simple, allowing a minimal interface for purchasing portions. A higher-performance interface

will be point-and-click with material appearing in separate Mac-style windows.

RECOMMENDED LAYOUT

There have been various complex arrangements (especially SGML) for the framing and presentation of text, especially local assignment of layouts to paragraph types. We will have such an arrangement, but within the framework of local applicative substructures.

THE HIGH-PERFORMANCE CLIENT

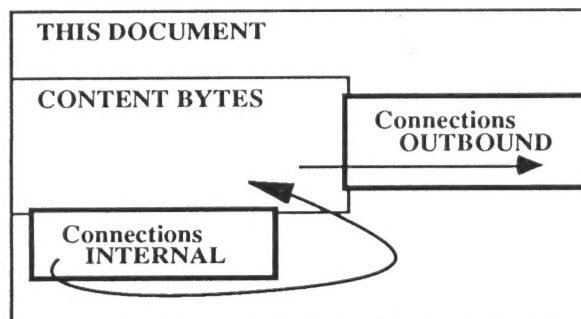
A very high-performance interface will also be specified at a later time.

For a higher level of performance, with panning, scrolling and zooms, as well as other effects, we will be specifying at a later time a high-performance client language called HyperFormance™. This will be closely related to multilayer compositing methods in video, and extend the video EDL (Edit Decision List).

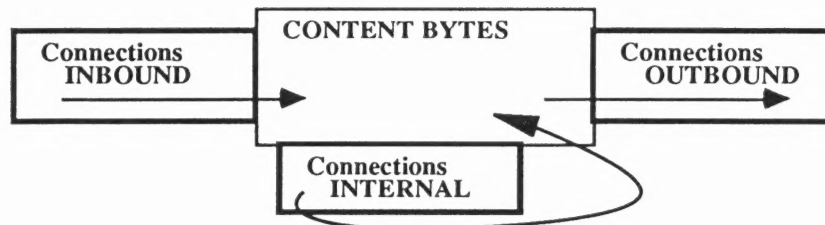
1. GENERAL MODEL OF A DOCUMENT.

A document consists of contents bytes (text, graphics, etc., ORIGINATING IN THIS DOCUMENT), and connections both in and out of the document.

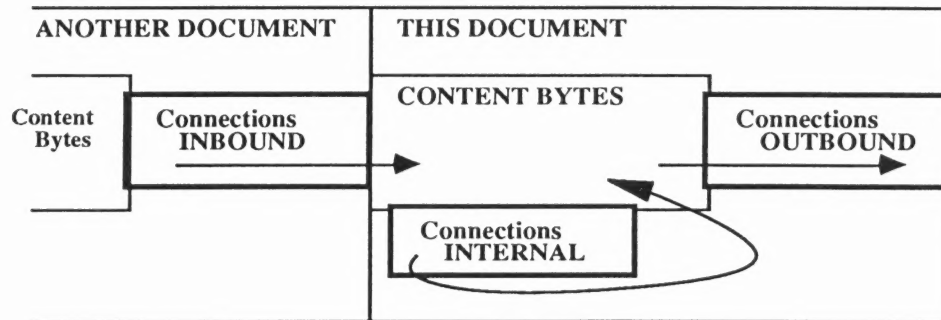
The structure document connections is APPLICATIVE, meaning that no codes are embedded. Structure is managed within the database system.



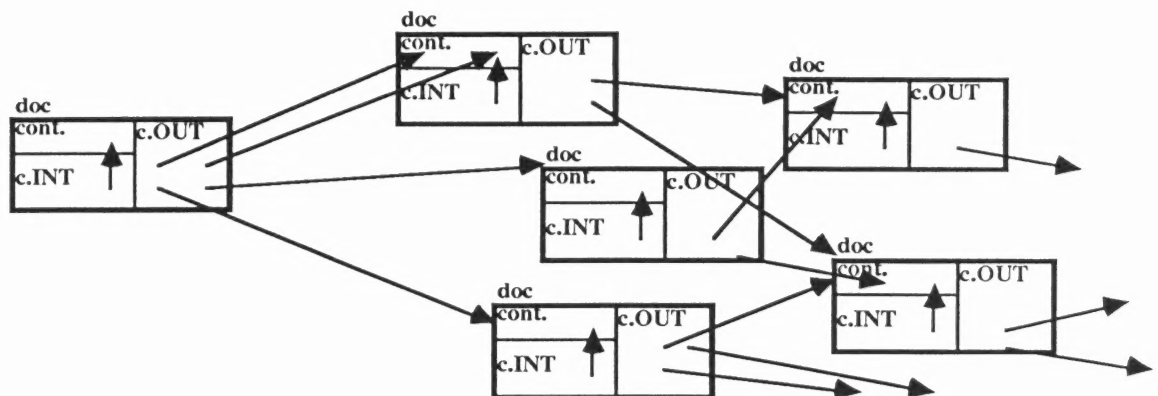
In relation to other documents, these connections create a symmetrical structure of connections:



All connections are owned. One document's inbound connection is another document's outbound connection.



Connections into one document are owned by other documents where they originate. Taken all together, these connected documents make up a docuverse.

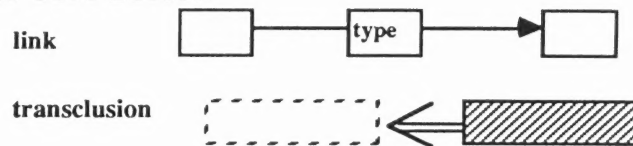
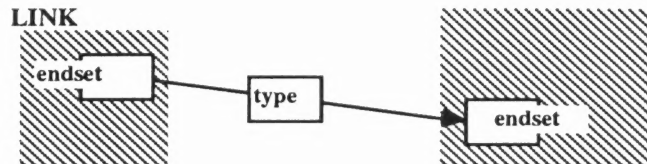


2. TYPES OF CONNECTIONS

There are two types of connections: links and transclusions.

A link is an arbitrary connection of any type.

A transclusion means a new instance: "bring in this material here," even though place of origin is different.

TYPES OF CONNECTION**LINKS.**

A link is a connector, of arbitrary extensible type, between part of a document and another part of a document. The link may be within or between documents.

TYPES OF LINKS

There can be many types of link, in an ever-extensible list. A short beginning list:

- Subject (what commentator thinks this is about)
- Comment
- Disagreement
- Endorsement
- Evidence
- Example
- Endorsement
- Graphical illustration

LINK ENDSETS

The endset is the material a link is attached to at either end (eg text, graphic, "hot button").

In Xanadu Light, there will be many types of endsets. These types will simply tell the system where the link is considered to be attached.

ENDSET COUPLINGS

The endset coupling specifies how it is attached: to a point, to a span of bytes, an area of picture, etc. Various different coordinate-spaces may be defined for this coupling.

Couplings can also be Deep or Surface. Deep couplings reach to data structure, whereas surface couplings reach the result of projecting the data structure. Example: a deep coupling to a PostScript document would couple to text

bytes inside the original PostScript code, a surface coupling would couple merely to an area of the output surface generated by the PostScript program.

LINK DIRECTIONALITY, VISIBILITY, FOLLOWABILITY

All Xanadu links can be seen from either end and followed from either end. Some people call this "bidirectional." This is incorrect. All our links are *bivisible* (can be seen from both ends) and *bifollowable* (can be followed from both ends).

Links are usually *directional*, that is, asymmetrical in meaning. Very few link types are symmetrical ("is related to" would be one possible example).

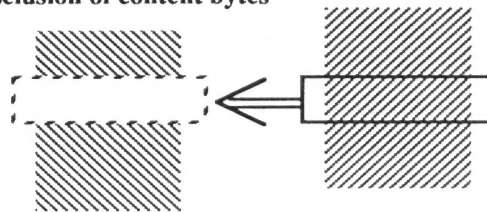
TRANSLUSIONS

A transclusion means "bring this material in here." The formal definition: virtual inclusion across a document boundary.

The material is not copied into the new document, but always newly-purchased from the original, or a functioning instance of the original.

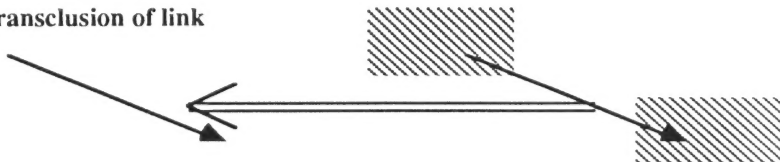
Content bytes, such as text and graphics, may be transcluded.

transclusion of content bytes



Links themselves may be transcluded. In practice this means that a connector of a certain type, and either its from -set or its to-set is transcluded.

transclusion of link



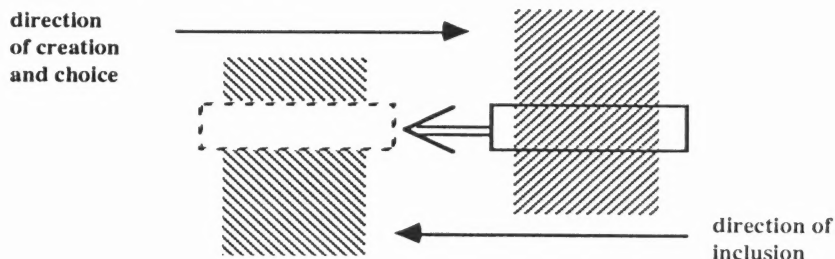
DIRECTIONS OF A TRANSLUSION

Transclusions, like links, are bivisible and bifollowable.

Transclusions are directional. To simplify things we say that a transclusion that brings in material is an outbound

connection. But there are of course two directions: the direction in which the material has been chosen, or the transclusion has been created (the *direction of creation and choice*), and the direction in which the material flows to be included (the *direction of inclusion*).

DIRECTIONS OF A TRANSCLUSION



3. STORAGE IN XANADU LIGHT

There will be two types of storage in Xanadu Light: content files, which may be anything that can be stored in a computer file, and database tables, which are the means by which the system will keep track of document structures.

Before considering the distinctions between content files and database tables, however, we will consider the logic of storage and payment.

4. EXTENDED STORAGE and the PAYMENT MODEL

THE PUBLISHER'S COMMITMENT

At the time of publication, the publisher pays for published materials to be stored on at least three nodes for at least three years.

This applies to contents bytes and required tables, including name tables, piece tables, outgoing connection tables, harpoon tables, and other tables that the evolving system may eventually require.

(These charges are not expected to be great.)

WHAT'S STORED TOGETHER LOCALLY

While the Xanadu docuniverse is a logical unity, in fact it will be dispersed, and so it must be designed to perform as if it were all in one place, at least insofar as possible.

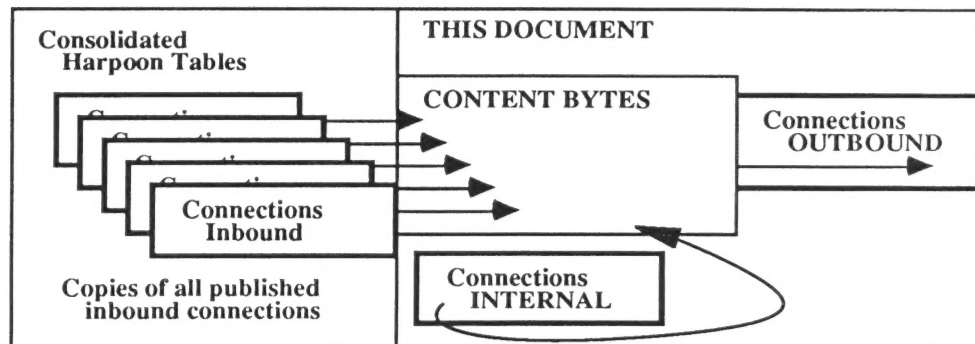
For this reason, various copies of materials will be stored together as needed.

Payment for these specific storages is part of the system design.

HARPOON TABLES for INBOUND CONNECTIONS

Because inbound pointers come from many other documents, copies of them need to be collected with the document they point to. This collection of inbound connections is the "harpoon table."

WHAT'S STORED TOGETHER



Payment for the storage of the harpoons is by the respective publishers of those connections.

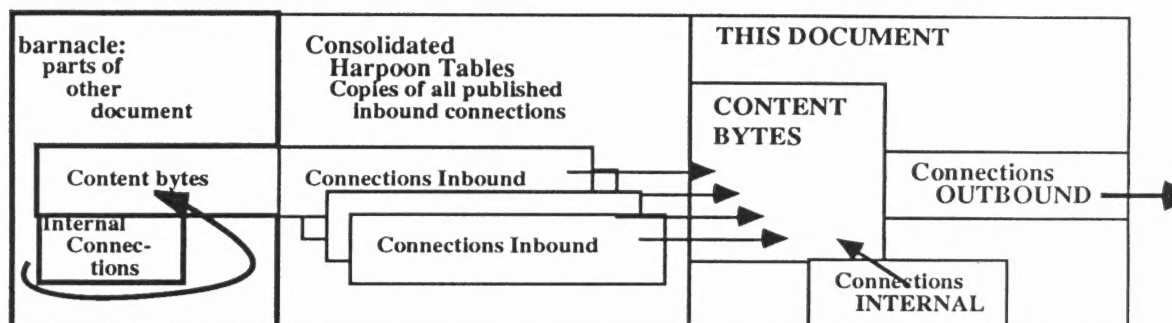
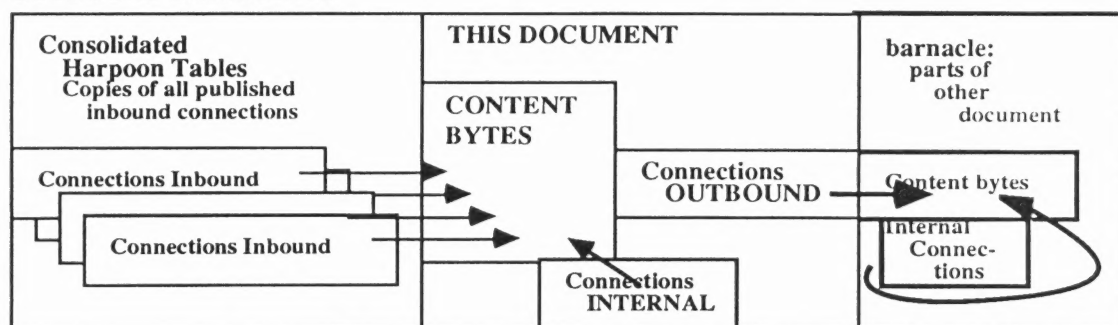
This is not optional. All published outgoing connections require the storage of an inbound harpoon.

BARNACLE STORAGE OF CONNECTED MATERIAL

A publisher may choose to store transcluded material with the document which requires them. This transcluded material is a local copy of parts of the other document, and remains the intellectual property of the first publisher. The new publisher pays for barnacle storage, but all royalties for the transclusion are passed on to the original publisher. The new publisher gains the advantage of being able to use the other material freely, though without direct royalty benefit.

Barnacle storage of a subdocument is logically just like any other document: it has its own piece table and connection tables.

Barnacle storage will be an option both for inbound connected material and outbound connected material.

INBOUND BARNACLES**OUTBOUND BARNACLES****SLOSH**

"Slosh" refers to the service provider making copies of documents, or parts of documents, for the convenience of providing service. It is anticipated that such copies will be made and destroyed freely, hence they will "slosh" throughout the system.

No royalty is paid for slosh copies, which are strictly for improved service. Royalties will be paid in the usual manner when materials are sent from slosh copies to end users.

OTHER SPECIAL CHARGES**SITE LICENSING**

A number of sites, such as corporations and libraries, wish to make a fixed payment for a document, rather than maintaining per-use charges. For such site licensing, an actuarial method will be used to estimate the probable revenues from a document at that site. Note that publishers are not required to consent to site licensing; site licensing is offered as an additional rider on the publishing contract which a publisher may

decline. This is because the per-use payment model is the most fundamental aspect of Xanadu publishing, and we do not wish to confuse it with other requirements.

FIRST-PUB PREMIUM

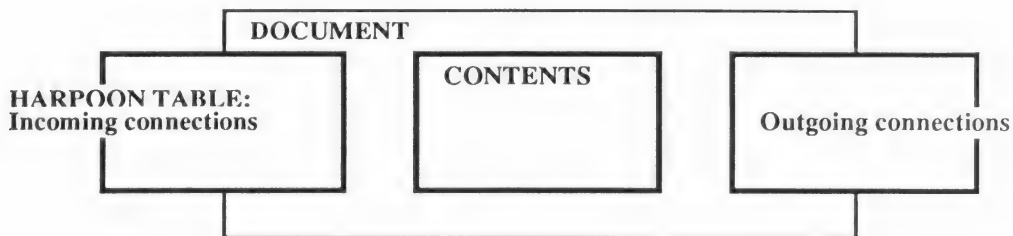
A portion of the service charge, including some minimum, will be remanded to the node of first publication whenever deliveries are made from a document. This provides additional incentive to service providers to acquire published material.

5. REPRESENTING THIS MODEL IN DATABASE TABLES

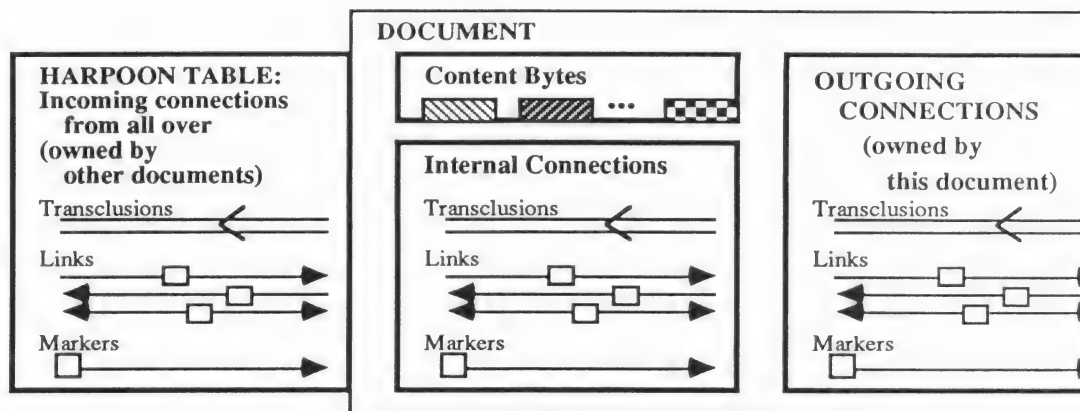
Note that this is an approximate listing of requirements. Avoiding redundancy and reducing it to sensible sets of contents are both critical.

THE DOCUMENT TABLES: OVERVIEW

Recall the simple model of the document: contents, internal links and markers, external links and markers.

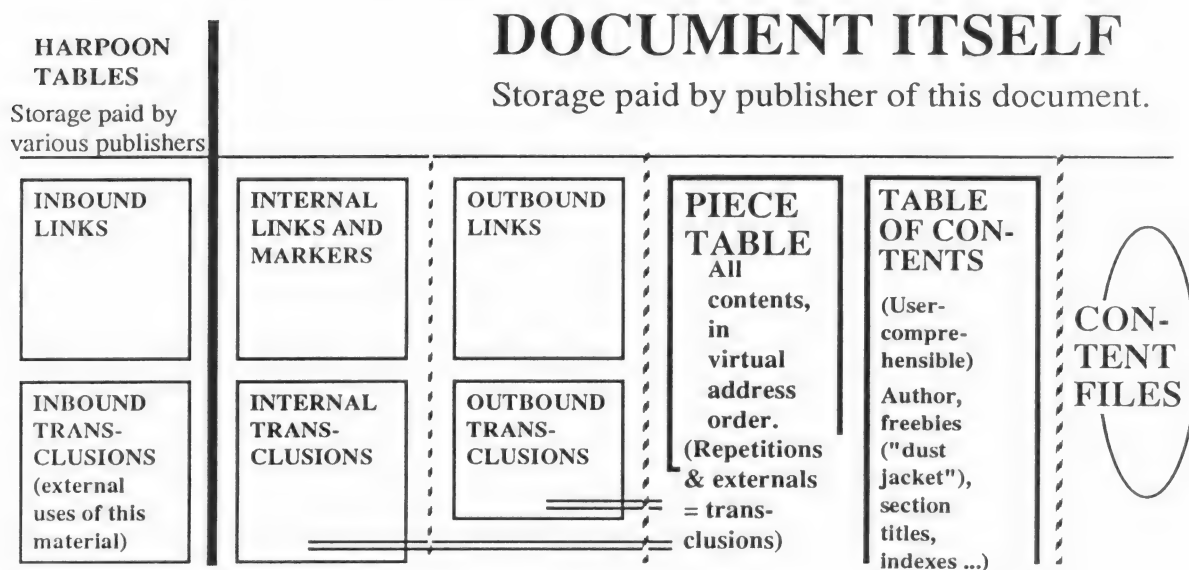


More fully, this consists of various specific types of connections in addition to the contents bytes.



In order explicitly to represent this as a system of database tables, a variety of tables are needed.

The link and transclusion tables are meant to be handled by identical mechanism. The other tables are separate.



(NOT SHOWN: Internet title tables for anonymous FTP, to be paid for by publishers.)

THE DOCUMENT TABLES: FURTHER DETAIL

THE TABLE OF CONTENTS

This shows the sections of a document that are of significance to the author and user, as distinct from the details of their origin, location and cost.

THE PIECE TABLE

The piece table is the internal technical structure which lists the location and ownership of the pieces of the document. They are listed according to the address sequence of a document; this address sequence may not refer to sequence of delivery or viewing, especially in a hypertext or hypermedia document.

The pieces may be stored in separate files in a single directory on the home node, if they are new material; they may be arbitrary portions of files on the home node; or they may be files or arbitrary portions of files elsewhere.

A piece has at least the following information:

Piece or Segment

Ordinal position

Location (THIS NODE OR
ELSEWHERE)

Copyright owner

Publisher on Xanadu

(If not on Xanadu, where)

(If not on Xanadu, terms of availability)

Royalty Rate

TRANSLUSION TABLES

Note that the outbound transclusion table is derived from the piece table, which lists pieces regardless of where they are stored. If they are not stored in the logical space of this document, they are transclusions. Transclusion tables should all be in the same format:

Piece

Data type

Length

Copyright owner

Publisher

Royalty rate per byte

LINK TABLES

Link tables should all be in the same format:

Endset

Left endset type

Right endset type

Left endset coupling

*(point, span, coordinate space,
surface vs. deep, etc.)*

Right endset coupling

Where

Where left endset applies: DocID,
Address*(implies location and length)*Where right endset applies: DocID,
Address*(implies location and length)*

What

Data type

Length

Copyright owner

Publisher

Royalty rate per byte

THE ACCOUNTING TABLES**CUSTOMER HISTORY TABLE**

Charges for private use

Payment for document deliveries

Storage of customer's private files

Table space for private database-managed
documentsService charges for private database-managed
documents**ROYALTY PAYMENTS OUT**

Modem connect time

Charges for Xanadu publishing

Publication registry fees

Content file storage

Service charges for database management
(local)Service charges for database management
(remote)Table space for customer's Xanadu-published
database-managed documents (local and
remote)

ROYALTY PAYMENTS IN (on customer's Xanadu-published documents)

CUSTOMER HOLDINGS TABLE

This table is stored at the customer's home node. It keeps track of the customer's privately stored materials and published materials.

Customer's publications

- Customer's Xanadu-published filenames
- Customer's Xanadu-published filespace
- Table space of published documents
- Document-management tables for published documents

Customer's private files and documents

- Private filespace
- Private filenames
- Document-management tables for private documents
- Table space of unpublished documents

DOCUMENT BUSINESS TABLE

(Accessible to document owner only.)

Note that any records kept of who has bought material will only be for preliminary debugging purposes. It is mandatory that in the long run such records NOT be kept.)

Usage history tables are maintained with barnacle copies, and are forwarded to the publisher's home node from time to time.

This contains:

- Date of publication

- Storage charges for harpoon-table entries

- Storage charges for barnacle files

- Storage charges and storage payments, by segment

 - Publishing registration costs

 - Storage, monthly

Down payment for three years

Bytes sold and royalty receipts, by segment
(A "segment" is a section of native data
of a particular type, or having a specific
royalty setting)

Transaction: amount and time

Transaction: amount and time

Transaction: amount and time

...

6. GENERAL DIALOG OF INTERACTION

The user will send for contents bytes or a set of links.

The user will pay for that delivery (including royalty on the contents bytes).

The system will deliver the content bytes or links.

The system will deliver a receipt, which serves as a re-entry ticket.

7. SESSION THREAD (advanced system)

In the advanced protocol, the user will present identification and get a session thread ticket. The ticket permits re-entry to the session without re-identification or re-establishment of credit.

After the first interaction, each receipt serves as the next ticket.

8. THE RECEIPT (advanced system)

Whenever a portion of material is sent out to a customer, a receipt is sent along with the portion to identify that portion. The user's system may store the receipt with the portion in order to keep acquired materials manageable.

The receipt is hashed against the piece as a form of authentication.

The purchaser may present this receipt as proof of the purchase if there are disputes on billing.

Receipts are demonstrably consecutive.

The receipt also provides authentication of the data, through hash codes. However, the hash is also against the purchase information, so that the material can only be authenticated along with who purchased it and when.